AMATEUR SATELLITE REPORT

Number 63
September 19, 1983

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AMSAT's Newsletter for the Amateur Space Program.

Amateur Satellite Report is endorsed by the American Radio Relay League as the special interest Newsletter serving the Amateur Radio Satellite Community

QRP Day Debuts To Rave Reviews

AMSAT OSCAR 10 operations took a very favorable turn this past week when on Monday, 12 September, the first QRP day was scheduled. Initial reports received by AMSAT officials indicated the event was a notable success. Maximum allowable ERP (effective radiated power) for QRP was 100 watts with the range of 50 to 100 watts put forth as a goal. Many stations apparently were delighted, if not astonished, to learn that good QSOs could be made using as little as 20 watts ERP or less.

While those with higher power available mostly obliged by turning down the "wick" to the recommended limits or less, those with 10 watts or less of 435 RF were well-pleased that their signals were now being heard and copied well. This resulted, according to AMSAT, because the satellite receiver AGC was no longer forced to cut back the transponder transmitter power. AGC activity and the resultant cutback of receiver gain occurs when too many excessively strong signals appear in the uplink passband. The consequence to lower power stations is most severe. Since the receiver sensitivity is reduced, only the stronger signals are transponded to the downlink. The irony lies in the fact that at the point where AGC cut-in occurs, the strong don't get stronger; the others simply disappear into the noise as all the available power is "sucked up" by a few uninformed QRO operators. So when QRP Day demonstrated so well that less than 100 watts ERP was all that was needed, a general glow of satisfaction set in.

It appears that the word IS getting around very quickly that QRO operation is not only impolite; it's a mark of an inexperienced operator; or worse!

Many of the initial problems with newcomers hearing the bird are disappearing too. *ASR* has learned that 2 meter preamp sales are very strong as the importance of "hearing" well becomes impressed on the psyche of hamdom. Quite a number heard on AO-10 have explained how well they have found their system to work with the preamp mounted at (or close to) their antennas.

With the first AO-10 QRP Day now history and a huge success as measured by the level of cooperation demonstrated, the weekly event seems sure to be one of the most popular operating features of the satellite. Spreading the spirit of cooperation seems the next challenge. To encourage development of the QRP spirit for AO-10, WA2LQQ is formulating a QRP engineering achievement award. The award would be available to all those demonstrating superior Mode B or Mode L "hearing" capability. Although the award is in the early planning stages, it would, according to WA2LQQ, be structured much as the ARRL Frequency Measuring Tests (FMT) were. Top awards would be made to those stations able to copy calibrated downlink signals very much below "normal" levels. Complications in structuring the award (such as assuring fairness by compensating/accounting for variations in range loss) remain to be detailed. More on this Engineering Excellence Award soon.

Several would-be QRP operators pointed to a potential dilemma. They point out that often the adjustment of uplink power is not as easy as rotating a pot. That is, many rigs have no audio gain controls for ssb and/or no level control for cw. Typically the operator might be able to manage three distinct power levels 10 dB apart. In this example he might have a 70 cm transceiver with normal output of 10 watts and low power position of 1 watt. He might also have a 100 watt 70-cm amplifier providing 10 dB gain. His output can then vary in 10 dB steps at 1, 10 and 100 watts. Given an antenna gain of 13 dB and a transmission line loss of 3 dB, this station could radiate 10, 100 or 1000 watts ERP. But nothing in between. Experience has shown that often a level of 100 to 300 watts ERP is just fine. What does this individual do?

Fortunately the technical solution is not a difficult one. What is called for is an attenuator "pad" that will reduce the ten watt transceiver output by a few decibels. (Attenuation could also be accomplished at the output of the amplifier but that is a bit impractical.) A lumped constant pad rated at 10 watts and presenting a good match to 50 ohms at 435 MHz is not a trivial matter although with care it can be built in the workshop. A design for a step attenuator based on varying lengths of relatively high-loss coaxial cables is planned for *Orbit* magazine soon. This should help those seeking the better "granularity" of power flexibility desired for those conditions where maximum power is definitely too much but medium or lowest power is not quite enough.

QRP days will continue each Monday UTC with uplink power not more than 100 watts ERP. Watch for further details on progress of this exciting new avenue of enjoyment on AMSAT OSCAR 10. And watch for announcement of the Engineering Excellence Award for those demonstrating superior Mode B or Mode L receiving capability.

Tracking Programs Proliferate

Amidst reports of occasional frustration in knowing where/when to look for AO-10, thousands are now using small personal computers to find "where it's at." The AMSAT Software Exchange is seeing very brisk business in software purchases. (Contact AMSAT HQ at P.O. Box 27, Washington, DC 20044 or call 301-589-6062). Meanwhile, the AMS-81 project continues to rack up new highs for sales of the program for the ZX-81 or TS-1000 micros.

(Contact Bob McCaffrey, KØCY, 3913 29th St., Des Moines, IA 50310). A couple of new entries are one designed for the Sinclair Spectrum developed by GM4 IHJ and two versions of the W3IWI basic for the VIC 20 and Commodore 64. N3AR reports his AMS-20/64 is being audited (tested) now and will be ready for distribution soon at $15 from AMSAT HQ. WØMFK's version likewise is approaching full readiness.

AMSAT nets began carrying AO-10 apogee times recently in response to suggestions from, among others, W2LV and W2RS, that this information could form the basis of an elementary tracking system using only the apogee times and a great circle map centered on (or near) one's QTH. In the simplest case, to locate the satellite azimuth at apogee, the beginner would take the apogee longitude and latitude as supplied in the AMSAT nets, mark the subsatellite point (SSP) on the map and then simply find the great circle bearing to that SSP. If the beginner is equipped with elevation control of his antennas, then all he need to do is elevate for maximum signal strength. Elegant! To offset from apogee pointing, a simple table showing degrees of change in longitude per hour, plus or minus, is all that is required. WB1EYI and W9KDR at ARRL had already begun disseminating this type of orbital information on W1AW. *ASR* offices received several additional requests for this type of orbital info in addition to the regular formats.

WØRPK advises that a couple of minor program changes to the AMS-81 program will avoid a possible glitch. Ralph specifies that line 1750 should be changed to read: IF LP U20 AND GO=U3 THEN GOTO HD2. Then line 2020 should be changed to read: IF LP U2O [rest of line unchanged]. A new line, 2105 should be added: LET GO = U

AMSAT Software Exchange manager N5AHD has provided a list of updates to software sources from the ASE. These include updated/corrections to programs for the TRS-80 Model III, TRS-80 Model 4 and IBM PC. These updates will be published in *ORBIT* # 15 next month. If you can't wait, however, you can send an SASE to *ASR* for a preview. Send to *ASR*, P.O. Box 177, Warwick, NY 10990. You should specify clearly what your request is (updates to the above programs only) and enclose a business sized SASE.

DL Report Cites Failure Mechanism

After an extensive study of the circumstances surrounding the failure of the AMSAT OSCAR 10 kick motor, AMSAT DL has released the following report. The report is quoted verbatim except for minor editorial changes for publication here.

I. General

As a consequence of the collision of the third stage of Ariane L6 with OSCAR 10, the orbit injection sequence had to be changed. This report presents what has been accomplished and what problems were encountered.

II. Planned Nominal Sequence

The spacecraft was designed to be separated from the launcher with a spin rate of 10 RPM and an orientation such that a small motor-driven maneuver could be performed on orbit 3. Following this maneuver, about four weeks were scheduled for reorientation and calibration of the OSCAR 10 attitude control system. When the correct attitude for a second spacecraft maneuver was attained, the spacecraft was to be injected into an orbit with 57 degree inclination and 1,500 km perigee.

III. Actual Sequence of Events

After the collision with the launcher shortly after separation, OSCAR 10 was spinning at minus 2 RPM. The sun angle was approximately 70 degrees. This attitude resulted in the spacecraft temperatures being very much below specifications. Moreover, the power production was extremely low. The low spin rate in conjunction with the aerodynamic drag at perigee resulted in a daily improvement of sun-angle of about 3 to 4 degrees. It was thus decided to not adjust the attitude until the sun-angle had improved sufficiently to bring power production and temperatures again into specifications and until the sensors allowed unambiguous atttiude determination.

These conditions were met one week after launch. At that time an emergency spin-up maneuver was initiated to allow the normal attitude control system to take over. The spin rate and attitude were adjusted to the first firing attitude until July 8. The first motor firing maneuver duration was increased because of the delay in first firing date and the consequential changes in sun-angle. The new post-first-firing values were to be 19 degrees inclination and 1,500 km perigee.

Local weather conditions at the primary control site prevented satisfactory telemetry reception on July 8 so the firing was moved to July 11. The first motor firing maneuver occured at 22:29 UTC. The motor performed flawlessly. However, it was later learned that the burn duration was 185 seconds rather than the planned 105.

The cause of the longer than planned burn was investigated and traced to a drawing error in the AMSAT-built Liquid Ignition Unit (LIU). The increased burn duration resulted in an orbital inclination of 25.9 degrees and a perigee height of 3,950 km. A secondary result of the extended burn was that the Helium bottle temperature dropped to minus 10 degrees C; again outside of its specifications.

One day later it was noticed that the low pressure Helium indication had dropped to one half of its nominal value while the high pressure reading remained about 200 Bars. Proceeding under the assumption the low pressure Helium gauge was at fault, we reoriented the spacecraft to the new firing attitude. On July 19 at 00:29 UTC the second firing was attempted. However, even though the magnet activation was confirmed, no firing occurred and there were no changes in the indicated pressures.

Consequently, the spacecraft reorientation was initiated such that operations could commence August 6 at 18:00 UTC using the existing orbit.

IV. Investigation into the Loss of Helium

Telemetry data from various control stations worldwide was collected until August 1 in order to reconstruct the pressure history of the spacecraft. From the data collected, it can be unambiguously inferred that the Helium loss occurred on the high pressure side of the gas system and that the time constant was 500 minutes. Furthermore, when the pressure fell below 7 Bars, the time constant changed to about 10 days. This finding rules out any leak in the motor or in the fluid tank system. An investigation with Messerschmitt-Boelkow-Blohm (MBB) on August 2 left only two candidate causes for the leak:

a) the seal of the Helium bottle

b) an "AN3" connection from the Helium pyrotechnic valve leading to a check point

Model calculations and the observed behavior of the Helium seal in earlier tests led to discarding the "AN3" theory as the cause of the leak. It is now concluded with a high degree of certainty that the Helium bottle seal caused the gas loss.

We believe the following conditions led to this gas loss:

1) The Helium bottle used in OSCAR 10 was developed by AMSAT DL with assistance from DEVLR [abbreviation unknown-Ed.] because the more conventional gas containers did not fit into the available physical space. The composite technology employed resulted in a bottle which could be specified for service only for temperatures above 0 degree C. Differential temperature expansion problems precluded hermeticity guarantees below 0 degrees C.

2) As a consequence of the poor sun angle subsequent to deployment, OSCAR 10 experienced a total of 14 cold cycles beyond its specifications early in its life. Some temperature excursions were to as low as minus 10 degrees C.

3) Shortly before the launch campaign, an error in the thermal design was discovered. The error would have resulted in operating temperatures 10 degrees lower than the design target for OSCAR 10. Using the limited resources available at Kourou the design could be modified only to the extent that 5 degrees of the 10 degree error could be recovered. As a result, the spacecraft temperature is 5 degrees lower than originally planned.

4) The extended burn led to another low temperature cycle of the Helium bottle to minus 10 degrees C.

Each of these conditions would not, taken separately, have resulted in a leak. However, the cumulative effect of the initial cold cycles probably reduced the tension of the helium bottle seal to about one half of its design value. The temperature drop during the first burn plus the pressure change likely reduced the seal tension sufficiently to have caused the leak.

The following evidence supports this finding:

1) The Helium high pressure indicator exhibits a shift of the zero-line by about 200 Bars. This pressure gauge is a strain gauge affixed to the bottle. The observed shift evidences irreversible bottle dome material deformation.

2) The change in the leak time-constant at 7 bars can be explained by the fact that the bottle seal contains a Teflon O-ring which, from prior experience, is known to seal between 5 to 10 Bars. (No such ring exists in the AN3 connection).

V. Conclusion for Future Phase III Spacecraft

a) The thermal design of the spacecraft will be changed to increase the temperature to a nominal design.

b) AMSAT will make every effort to replace the solid propellant motor planned for Phase IIIC by the MBB liquid propulsion system. A solid propellant motor would not have survived the thermal abuse of OSCAR 10. The liquid propulsion system provided margins that were instrumental in saving the mission.

c) For Phase IIIC, AMSAT will attempt to redesign the Helium bottle such that its operating temperature can be specified to minus 10 degrees C.

VI. Conclusion Regarding Operations of OSCAR 10

The present orbit of OSCAR 10 provides about 40 percent of the radio coverage compared to the originally planned 57 degree inclination orbit.

Furthermore, the low inclination forces antenna off-pointing and/or operational quiet times for about 40 percent of the time because of sun-angle constraints. Consequently, operational capability of OSCAR 10 is reduced to about one fourth of its planned value. Also, because of the 17 day periodicity of the satellite's footprint, unfortunate week-long interruptions in East-West traffic (e.g., over the North Atlantic) results.

On the positive side it may be noted that OSCAR 10 can meet all its scientific objectives and that the communications capability is so large that even one fourth of its nominal capability represents a very significant communication potential for amateur radio operators. This is all the more true since this is the first working spacecraft of this series and the users can take only previous OSCARs as basis for comparison. Plainly, OSCAR 10 presents a dramatic improvement.

Ham-In-Space Flies Next Month

The amateur radio media is buzzing with anticipation of next month's premier public relations event: Astronaut Dr. Owen Garriott, W5LFL, will become the first amateur to operate from space. Owen will operate a specially designed Motorola 2 meter HT from the space shuttle Columbia. Lift-off is scheduled for 28 October.

With some 6 weeks to go, some details of the flight profile are becoming known although there has been some confusion in the media regarding when and where the STS-9 will be on the air. Operating times for W5LFL/Space Mobile will be constrained in several ways. Dr. Garriott must be on "crew rest" time so as not to interfere with mission operation. In addition, the spacecraft must be properly oriented. Since the antenna to be used, a split ring DDR, will be mounted in a window adjacent to the cargo bay, that window of Columbia must be turned to face the earth if 2-meter communications are to be successful. That places the bottom of Columbia to the sky and the cockpit towards the earth. Those having seen the spectacular new ARRL vidoetape, "Amateur Radio's Newest Frontier" will have a much better understanding of where the antenna is mounted and what is required to work W5LFL/space mobile.

The DDR antenna was chosen primarily for its radiation pattern which is strongest along the axis perpendicular to the ring. That is, best signals will be heard on the ground directly beneath Columbia with lesser signals heard along the sides of the ground track. The Motorola HT puts out 5 watts at 2 meters and has a special battery pack designed for high power, space use.

ASR will feature the full details of amateur radio operations next month when the final details and especially the ground track are firmed up. Meanwhile, the planned operating frequencies are included elsewhere in this issue.

Amateur Radio has a long and proud history of public service. But for the most part it maintains a rather low profile as far as public exposure is concerned. When major disasters occur hams are occasionally spotlighted in the public media for having provided invaluable communications. On some occasions hams get no mention whatsoever despite hundreds of man-hours of effort, risks and occasional injury or even death to those who would be rescuers and communicators. With STS-9/Ham-In-Space ala Owen Garriott, Amateur Radio has what has got to be its best-ever shot at pure, positive public exposure.

"Spacey" things still capture the imagination of the public. But it takes more today to capture the imagination of a city editor or a network news editor than it used to. STS-9 has, we reckon, all the right ingredients to cast amateurs in a very positive light. After all, the public has come to associate hams mostly with doing good deeds during hurricanes, floods and tornadoes. The more literate will have read about the Walk-athon communications, etc. But here is the pure positive press exposure. No flood. No deaths. No property damage. Just hams participating in a leading technology; space technology! What a perfect opportunity to make a lasting positive impression.

All things in balance, what if it doesn't happen? Well we should be prepared should some unforseen event curtail or even postpone this first ham-in-space expedition. Many contingencies could upset the apple cart. Let us merely put the risks in perspective and hope that many, many amateurs are lucky enough to QSO with Owen; that others are satisfied to have heard him direct from space on their rigs and that the media does justice to this very positive circumstance in which hams now have the opportunity to appear!

Short Bursts

- An AMSAT OSCAR seminar will held at the ARRL Great Lakes Division Convention 25 Sept. Senior VP K8OCL will be at the Cleveland event for the 9:30 to 11:00 A.M. seminar. Stop by!
- Don't forget to notify AMSAT HQ of your intent to attend the AMSAT Space Seminar/Annual Meeting in Laurel, MD, 12 Nov. 83. Lots of interest in this event is evi-

dent. Don't miss out.

• K1HTV has decided to not run for re-election as Director. That leaves four newcomers (W3OZ, W6XN, W8GQW, WØRUE) and three incumbents (W6SP, W3GEY, VE2VQ) in for the four seats up for grabs. Ballots due to be sent out about 1 Oct. *ASR* will publish platform statements of the candidates in two separate issues in October.

AO-10 Apogee Times

Date	Apogee Time (hh:mm:ss)	Apogee Longitude
Sept. 19	09:38:56	120E
19	21:18:27	55W
20	08:57:59	129E
20	20:37:30	46W
21	08:17:01	139E
21	19:56:32	37W
22	07:36:03	148E
22	19:15:34	27W
23	06:55:05	157E
23	18:34:36	18W
24	06:14:07	167E
24	17:53:39	8W
25	05:33:10	176E
25	17:12:41	1E
26	04:52:12	174W
26	16:31:43	10E
27	04:11:14	165W
27	15:50:45	20E
28	03:30:16	156W
28	15:09:47	29E
29	02:49:19	146W
29	14:28:50	38E
30	02:08:21	137W
Sept. 30	13:47:52	48E
Oct. 01	01:27:23	128W
01	13:06:54	57E

Notes: Time increment (anomalistic period) = 699.518484 minutes (per MH-9-13-83). Longitude increment = 184.7 deg. east per orbit or 9.4 deg. east per 2 orbits. Average latitude of apogee for period covered is approximately 12 deg. N.

From KA9Q

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Satellite: oscar-10
Catalog number: 14129
Epoch time:       83257.00000000
   Wed Sep 14 00:00:00.000 1983 UTC
Element set:      MH 9-13-83
Inclination:        26.0670 deg
RA of node:        241.3370 deg
Eccentricity:     0.6040293
Arg of perigee:    202.7550 deg
Mean anomaly:      136.6490 deg
Mean motion:     2.05855890 rev/day
Decay rate:               0 rev/day^2
Epoch rev:              190
Semi major axis: 26105.538 km
Anom period:     699.518484 min
Apogee:           35496.521 km
Perigee:           3959.501 km
Translate freq:    581.0047 mhz
Invert:                   1
Beacon:            145.8100 mhz
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W5LFL/STS-9 Frequency Table

The frequencies listed below are those to be used by W5LFL. Frequency designators beginning with A, B or C are intended for use over IARU Region 2. Regions 1 and 3 which have different bandplans will be served by frequency designators beginning with D.

Designation	Shuttle Transmits	Shuttle Receives
A1	145.53	144.91
A2	.53	.93
A3	.53	.95
A4	.53	.97
A5	.53	.99
A6	.53	145.01
A7	.53	.03
A8	.53	.05
A9	.53	.07
A10	.53	.09
B1	145.55	144.91
B2	.55	.93
B3	.55	.95
B4	.55	.97
B5	.55	.99
B6	.55	145.01
B7	.55	.03
B8	.55	.05
B9	.55	.07
B10	.55	.09
C1	145.57	144.91
C2	.57	.93
C3	.57	.95
C4	.57	.97
C5	.57	.99
C6	.57	145.01
C7	.57	.03
C8	.57	.05
C9	.57	.07
C10	.57	.09
D1	145.55	144.70
D2	.55	.725
D3	.55	.75
D4	.55	.775
D5	.55	.80
D6	.55	.825
D7	.55	.85
D8	.55	145.35
D9	.55	.45
D10	.25	144.65
D11	.575	.975

Help Wanted

Project Manager — To manage AMSAT's Name in Space Project as described in August *QST*, page 127. Administrative duties. Contact N2CF at AMSAT HQ.

Technical Writer — To author a small brochure on "How to Use OSCAR Satellites". Brochures to be placed on amateur radio sales counters and in equipment containers. Must write clearly; thorough understanding of OSCAR satellites required. Contact N2CF at AMSAT HQ.

Amateur Satellite Report is published and mailed First Class bi-weekly for the Radio Amateur Satellite Corporation. The purpose is to enhance communications about the Amateur Radio Satellite Program. Subscription rates for the United States, Canada, and Mexico are $22.00; Foreign is $30.00. The rate covers 26 issues (typically one year). Send check or money order in U.S. funds (drawn on U.S. banks only please) to "Satellite Report," 221 Long Swamp Road, Wolcott, CT 06716. Information contained herein may be quoted without permission provided credit is given to Amateur Satellite Report, Wolcott, CT 06716. *Amateur Satellite Report is Copyright Protected and duplication of this publication in any way including by the photocopy process or by electronic means (computer data banks, etc.) is not permitted under any circumstances.* *Amateur Satellite Report is endorsed by the ARRL as the special interest newsletter serving the Amateur Radio Satellite Community. The editorial opinions expressed are not necessarily those of the ARRL.*